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| **NAME:** | **TEACHER:** |

**MATHEMATICS, 2010**

# Level 1

**Papers**

## 90147 Use straightforward algebraic methods and solve equations Page 2

90148 Sketch and interpret graphs Page 10

90194 Determine probabilities Page 17

90151 Solve straightforward number problems in context Page 23

90152 Solve right-angled triangle problems Page 30

90153 Use geometric reasoning to solve problems Page 37

**MATHEMATICS, 2010**

# Level 1

## 90147 Use straightforward algebraic methods and solve equations.

# Credits: Four

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

|  |  |  |
| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Use straightforward  algebraic methods.  Solve equations. | Use algebraic methods and solve equations in context. | Use algebraic strategies to investigate and solve problems. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You are advised to spend 30 minutes answering the questions in this booklet.

You should show clear working for each question.

You should try to answer all parts of both questions.

QUESTION ONE

(a) **Expanding and factorising**:

(i) Expand and simplify (x + 5)(3x – 2)

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(ii) Factorise x2 + 5x – 66

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(iii) Expand and simplify 7(p + 1) + 2(p – 5)

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(b) **Simplify fully**

(i) (y7 ÷ y5)(2y3)2

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(ii) 24m6

18m2

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(iii) 7p2 – 3m - 5p – 2p2 + 7m - p

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(c) (i) **Factorise** x2 – 25

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1. **Simplify** x2 – 9

x + 3

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1. **Simplify**  + 

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(d)

(i) The higher you are, the further you can see to the horizon (assuming there is nothing blocking your line of sight).

The formula for this is D = 

where D is the distance you can see (in kilometres), and h is how high your eyes are above sea level (in metres).

**How far can you see if you are on a hillside looking out to sea and your eyes are 36 metres above sea level?** **Give your answer to 2 d.p**.

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1. **Rearrange the formula** D = **to make h the subject.**

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(e) On Christmas day 2007 a tiger leapt from its enclosure at San Francisco Zoo. Official guidelines said a wall to contain tigers should be 5 metres high. The zoo’s wall was only 3.8 metres high, but the tiger also had to jump a 10 metre moat.

Moat

3.8 m

high

10 m

The tiger could run at the moat before leaping at the wall (curved path). With a 5 metre run-up, tigers reach 14 metres per second at take-off.

This formula calculates how fast an animal has to be moving to be able to leap over a moat AND a wall.

V = √(9.8(h + √(h2 + w2) )

where V = takeoff speed, h = height of wall w = width of moat.

(i) **Would the tiger have been able to leap over a wall 5 m high if it was running at 14 metres per cecond?** **You must support your answer with calculations using the formula**.

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1. If it wasn’t possible to make the wall higher than 3.8 m, then you could make the moat wider.

**By rearranging the equation to make w the subject, calculate how wide a moat is needed to contain a tiger running at 14 metres per second?**

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QUESTION TWO

(a) **Solve these equations:**

(i) (7 – x)(2 – 5x) = 0

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(ii) 2m + 6 = 33

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(iii) 15 – 4x = 8x – 12

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(b) **Solve these equations:**

(i) 7y + 6 = 5y + 1

2 3

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(ii) x2 + 9x = 52

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1. Jack is building a pyramid by leaning cards against each other. He starts with 2 cards like this:

This is a ‘1-level’ pyramid and it uses 2 cards.

By making the base wider, and putting a ‘floor’ between each level, he can make higher pyramids, like this:

As you can see, a ‘2-level’ pyramid uses 7 cards,

a ‘3-level’ pyramid uses 15 cards and so on.

**Write an equation showing how many cards are needed (c) for an ‘n-level’ pyramid.**

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(d) Jack and Pam meet in town for lunch. Jack orders 3 sandwiches and 2 cakes. This comes to $11.05. Pam orders 2 sandwiches and 1 cake. This costs $6.50

**If the price of a sandwich is s, and the price of a cake is c, solve these equations to find the values of s and c:**

3s + 2c = 11.05 2s + c = 6.5

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(e) **By writing and solving relevant equations find the volume of this cuboid carton:**

Front **area** = 61.74 cm2

Top **area** = 50.96 cm2

End **area** = 32.76 cm2

To get full credit for this question you must show the equations you have written.

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**MATHEMATICS, 2010**

# Level 1

## 90148 Sketch and interpret graphs.

# Credits: Three

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

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| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Sketch, and interpret features of, graphs. | Sketch, and interpret features  of, graphs.  Write equations for linear graphs. | Determine and apply an appropriate model for a situation involving graphs. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You are advised to spend 30 minutes answering the questions in this paper.

You should show any working needed to support your answers.

You should attempt all parts of all questions.

QUESTION ONE

(a) **Use the grids to draw the graphs of:**

(i) y =  – 2



(ii) y = (x – 3)(x + 2)



(b) (i) y = x2 – 6x + 5

=(x – 3)2 – 4



(ii) y = – x( – 4)



(c) A railway over a gorge is supported by 2 arches. The first arch (Arch 1) is in the shape of a parabola with the equation:

h = -2(w – 2)(w – 12)

where h = height above ground and w = distance (width) across the gorge.

The railway line is 2 metres above the highest point of the arches

Diagram is NOT drawn to scale.

2

2 metres thick

Railway line

Arch 1

Arch 2

16

A

B

Width (distance) across gorge = w

Height above ground = h

i/ **Write the equation of the railway line AB:**

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The 2nd arch is an exact copy of the 1st, but it starts at w = 16. The equation of this arch is:

h = ax2 + bx + c

ii/ **say what a, b and c are in the equation of Arch 2.**

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QUESTION TWO

(a) Andre and Sarah live at opposite ends of a straight beach. They decide to meet in between and swim. Andre sets off towards Sarah’s house.

He walks at a constant easy speed. After 20 minutes he has walked 1000 metres. Sarah leaves her house 15 minutes after Andre leaves his. She walks quickly towards Andre. All of this is shown on the graph below:

1000

2000

3000

d

10

20

30

40

50

60

Time in minutes

B

C

A

E

D

Distance from Andre’s House in metres

t

(i) **How far apart are Sarah’s and Andre’s homes?**

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(ii) **About how** **many minutes after Andre sets off does he meet Sarah?**

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(iii) **How fast does Sarah walk?**

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(iv) **Write the equation of the line from A to B**.

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(v) **Write the equation of the graph from B to C.**

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(vi) Part of each of the lines BC and DE don’t make sense given what you are told. **Which parts, and why don’t they describe what will actually happen?**

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(c) Nicolas has a farm for sheep and cattle. But of course there is only so much grass. The more sheep he has, the less cattle can be fed, and vice versa. It turns out that the combined number of sheep and cattle he can have fits this equation:

8y + 20x = 80

where y = how many hundreds of sheep and x = how many hundreds of cattle there are on the farm.

(i) **Sketch the graph of 8y + 20x = 80 on the grid below:**



(ii) **Explain in terms of the animals farmed, what the y intercept represents.**

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(iii) **Explain the range of x values allowed by this model, and why x values outside this range cannot be used.**

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(d) An athlete is practicing the shot put. She ‘puts’ the shot by pushing it into the air with as much power as possible, and tries to direct it at the best angle to achieve maximum distance over the ground.

On one attempt, the shot’s path through the air can be modeled by a parabola as shown here:

2 m

8 m

Maximum height 5.2 m

Diagram is NOT drawn to scale.

A

B

The parabolic path of the shot starts when it leaves the athlete’s hand at a height of 2 metres.

It reaches its highest point of 5.2 metres after traveling 8 metres **horizontally**.

**Write the equation of the shot’s path and use the equation to calculate the horizontal distance the shot travels from A to B.**

You must show the equation you have formed and the calculations used to support your answer.

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**MATHEMATICS, 2010**

# Level 1

## 90194 Determine probabilities.

# Credits: Two

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

|  |  |  |
| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Determine probabilities. | Solve probability problems using theoretical methods. | Explore probability situations to solve problems. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You are advised to spend 25 minutes answering the questions in this booklet.

You should show all working.

You should attempt all parts of both questions.

QUESTION ONE

(a) Here is a table showing details about call-outs by the New Zealand Fire Service.

Types of incident to which Fire Service was called (000s)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Year 1 | Year 2 | Year 3 | **Total** |
| Fires | 18 | 21 | 18 | **57** |
| Hazardous substance emergencies | 2 | 2 | 2 | **6** |
| Vehicle incidents | 7 | 8 | 9 | **24** |
| Medical emergencies | 2 | 3 | 4 | **9** |
| Other emergencies | 5 | 5 | 7 | **17** |
| False alarms | 20 | 22 | 24 | **66** |
| **Total** | **54** | **61** | **64** | **179** |

1. **What is the probability that, in year 3, a call-out was a false alarm?**

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Probability (false alarm): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii) A safety manager wants to study in detail some particular call-outs to see if procedures can be improved. He chooses a call-out at random from any year. **What is the probability he chooses a ‘Vehicle Incident’ to study?**

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Probability (Vehicle Incident) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(iii) In fact, the safety manager has chosen a ‘Fire’ call-out. **What is the probability he has picked one from Year 1?**

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Probability (Year 1): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) Insurance firms always need trained people to check the probability of bad events.

In one city, the probability of a car being stolen in any year is 0.03 for cars 5 years old or less, and 5% for cars older than 5 years. Out of every 10 cars, 7 are older than 5 years. This probability tree shows some of this information:

5 or less yrs old

Over 5 yrs old

.03

5%

Stolen

Not Stolen

Stolen

Not Stolen

7

10

1. **What is the probability of a car picked at random turning out to be over 5 years old and being stolen in the year?**

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Probability (older than 5 yrs & stolen) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(ii) **What is the probability of a randomly chosen car being stolen in the year?**

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Probability (car being stolen) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(iii) An insurance company is told that one of their customer’s has had their car stolen. **What is the probability the car turns out to be over 5 years old?**

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Probability (stolen car being older than 5 yrs) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) A rare, but serious disease called Wolfgram syndrome, occurs in 7 out of 1000 men; (0.7% of the male population)

A test can spot the disease before the man gets sick, so treatment can be started in time to cure it. However, like all these tests, sometimes the result is wrong.

**For men with the disease**, the test will find it 91% of the time. But, for the other 9%, the test result will wrongly say they don’t have the disease (meaning the disease is not treated in time).

**For men who do not have the disease**, the test shows this 94% of the time, but the other 6% of results say the man tested actually has the disease, when in fact they don’t (meaning unnecessary stress and wasted treatments).

A randomly selected man is tested.

**The test** **shows he has Wolfgram syndrome.** **What is the probability he actually does have Wolfgram syndrome?**

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QUESTION TWO

Lotto is a popular and simple game. You pick 6 numbers from 1 to 40. The 6 numbers you pick are called a line.

Then 40 balls (numbered 1 to 40) are mixed in a barrel and 6 of them are randomly rolled out of the barrel. If your 6 numbers match those on the 6 balls, you win the big prize.

You can also win smaller prizes if you only get some of your numbers matching the balls.

Note: Once a ball comes out of the barrel, it stays out. It is not put back in. So any number can only come up once in a draw.

1. **What is the probability that the first number out of the barrel is 10?**

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Probability (1st number drawn = 10) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **What is the probability that the first number out of the barrel is less than 10 (i.e. 1 to 9)?**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Probability (1st number drawn is less than 10) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **If you buy one line of Lotto (6 numbers),** **what is the probability that both of the first 2 numbers out of the barrel will be numbers in your line?**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Probability (1st 2 numbers in same line): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Kay thinks ‘5’ is her lucky number so always includes it in her picks. If there are 52 draws in a year, **how many times in a year should Kay expect to see 5 be one of the 6 numbers drawn?**

Justify your answer with calculations, diagrams or a written explanation.

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Expected number of 5s in 52 draws: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Some friends get together and pool enough money to buy lots of lines. Remember a line is 6 numbers.

After 2 balls have rolled out, it turns out 136 of their lines have **exactly one** number correct (one out of the first two numbers). This is **exactly** the number that you would **expect** from the number of lines they purchased.

**Using this information calculate how many lines they purchased and also how many lines would be expected to have both of the first 2 numbers correct.**

**Note: To get full credit for this question you must calculate your answers based on probability theory. Show your working.**

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Number of lines they bought: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Number of lines you expect to have both numbers correct: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**MATHEMATICS, 2010**

# Level 1

## 90151 Solve straightforward number problems in context.

# Credits: Three

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

|  |  |  |
| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Solve straightforward number problems in context. | Solve number problems in context involving manipulation, several steps  or reversing processes. | Devise a strategy and solve a number problem. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You should show clear working wherever possible. To get full credit it is often required that your methods are shown as well as your answer.

You should try to answer all parts of both questions.

QUESTION ONE

(a) Here is a barcode numbers. It uses what’s called the ISBN 13 system. It should have 13 digits in each code **but the last digit is missing**. Follow the steps below to work out the missing digit.

4 039155 03011\_

Step 1/ Add up every digit in an even position (i.e. the 2nd digit plus the 4th digit, plus the 6th digit etc).

Step 2/ Multiply your total from step 1 by 3.

Step 3/ Then add all the digits in the odd positions (1st, 3rd, 5th etc) to the answer you have from step 2.

Step 4/ Now, if you are told your final total **must** be a multiple of 10, **what must the missing digit be?**

Remember to show your calculations.

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Missing digit is:\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) In 2011, New Zealand is hosting the Rugby World Cup. Teams from all over the world will play in the tournament.

*  of all the teams will come from Europe
*  will come from the South Pacific
*  will be from Africa

**What fraction is made up of teams from other parts of the world?**

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Fraction from rest of world = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) If you earn wages in New Zealand your employer must subtract part of what you earn; and instead of giving it to you, they give it to the government. This is income tax. The amount deducted is a percent of what you earn.

For Alex, the tax will be 14.2% of her income.

Alex opens her pay packet one week and discovers she has been paid $195.70 after the tax has been deducted.

**What was her pay before the tax was deducted?**

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Alex’s pay before tax = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(d) Diamond cutting is a very difficult skill. If you get it wrong the diamond will lose a lot of its beauty and also a lot of value.

Here is a side-on diagram of a ‘brilliant cut’ diamond. All the lengths and angles must be extremely accurate to ensure that light bounces around inside the diamond so that the sparkle and ‘fire’ of the diamond is at its best.

A

B

C

This diamond has been cut so that the 3 lengths shown (A, B and C) are in the ratio 500 : 275 : 81

**If the width of the diamond (length A) is 6 mm, how long is C?**

**Give your answer in standard form to 3 significant figures.**

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C = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(e) Andre is buying his first car. He wants to work out what it will cost for every km he drives.

He asks for your advice, and to help you he gives you these figures:

* Routine servicing and Warrants of Fitness will be needed twice a year. This will be about $300 plus 12.5% GST each time. All other costs below include GST.
* Insurance will be $23 per month.
* The car has to be licensed and this costs $250 each year.
* Petrol costs about $1.90 per litre. However Andre’s flatmate Geoff, has agreed to pay ¼ of **all** petrol costs in return for Andre taking Geoff to work 5 times a week.
* He will get 12 km for each litre of petrol. He will drive 160 km per week.
* Andre is now paying $7 per week in bus fares. He will save that when he has a car.
* There are 52 weeks in a year.

Assuming all of these figures are accurate, **calculate what the car will end up costing Andre per km driven.**

**Show all working and clearly show what you are calculating at each step.**

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QUESTION TWO

(a) Robin is starting university, doing a science degree and is interested in sea life. She has to buy textbooks. They cost $970 new, but she can buy them 2nd saving her 45% on average.

**What will her books cost if she buys them 2nd hand?**

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Price of 2nd hand books = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) Robin and 2 friends find a 3-bedroom house to rent for $315 per week. However one bedroom is bigger and better than the others. They agree the person who gets the better room will pay more. They agree to share rent in the ratio 2 : 2 : 3

**How much will each person pay in rent?**

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Rents are: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) Robin has an important assignment counting very small creatures called protozoa and copepods in seawater. She wants to know how water pollution affects them.

In one of her samples, the ratio of protozoa to copepods is 10 : 1 and she estimates there are 250 copepods in the sample. After adding a chemical, the number of copepods fall by 20% and the ratio of protozoa to copepods alters to 17 : 2

**By what percentage has the number of protozoa changed?**

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Percent change =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(d) New Zealand controls a very large part of the ocean around our country. Living in this ocean are very very small plants and animals called plankton.

It has been worked out there are 4.0 x 1014 cubic metres of plankton-holding water inside New Zealand’s ocean boundaries.

The plankton is 0.0165% of this volume.

A cubic metre of plankton weighs 1100 kg.

One special form of plankton is called Phytoplankton. It is extremely important in the ocean’s food chain. The ratio of Phytoplankton weight to other plankton weight is 31 : 49

**What is the weight, in kg, of the phytoplankton in New Zealand’s sea water? Give your answer in standard form to 4 significant figures**.

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**MATHEMATICS, 2010**

# Level 1

## 90152 Solve right-angled triangle problems.

# Credits: Two

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

|  |  |  |
| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Solve right-angled triangle problems. | Solve problems in practical situations involving right-angled triangles. | Solve problems in word or 3D situations. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You are advised to spend 30 minutes answering the questions in this booklet.

You should show all working.

You should attempt all parts of both questions.

QUESTION ONE

Tracey is designing a landscape plan for her new house. Two fences meet at corner P.

This corner of the garden will be made into a triangular flower bed by laying a wooden ‘edge’ from R to Q.

PR is 4.9 metres long. PQ is 6.2 metres long.

R

P

6.2 m

4.9 m

Q

Diagram is NOT drawn to scale.

1. **What length of edging is needed to go from R to Q?**

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Distance RQ equals \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(b)** **What is the angle formed by the edging and the fence at Q?**

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Angle PQR equals \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) The fence needs repairing. The rail from A to B is rotten.

A

0.85 m

Diagram is NOT drawn to scale.

D

B

C

ABCD is rectangular (corners all 90°). The fence height, BC, is 0.85 metres.

The diagonal brace BD is 2.1 metres long.

**How long is the rail from A to B**?

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Length AB = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(d) A watering system is installed using a pipe under a rectangular garage floor from T to U as shown in the plan:

6.4 m

S

P

R

Diagram is NOT drawn to scale.

Q

T

U

1.3 m

The floor is 6.4 metres from R to S. Angle STU is 79◦.

**Calculate the length of pipe TU.**

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Length TU =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(e) **If length PT is 1.3 metres, how long is length QU?**

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Length QU =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Another part of the watering system involves 3 pipes forming a triangular pattern as shown below. Water enters the system at A.

One pipe is laid on **a bearing** of 288◦ towards junction B which is 18.3 metres from A.

A second pipe follows **a bearing** of 252◦ from A to C.

**If angle ABC is 103◦, how long is the pipe from A to C?**

Diagram is NOT drawn to scale.

A

B

C

18.3 m

N

103◦

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QUESTION TWO

(a)

73 metres

17 metres

A

B

C

Diagram is NOT drawn to scale.

Sally rows over a river from A to B. She tries to row straight across the river, but a current pushes her off course to C.

The distance AB is 73 metres, and BC is 17 metres.

**What angle has the boat traveled off course (angle BAC)?**

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Angle BAC = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) **And how far has the boat actually traveled from A to C?**

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AC = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c)

Later the current changes and a second boat crosses the river.

50 metres

19◦

D

F

E

Diagram is NOT drawn to scale.

Traveling along line DE, 19◦ off course, the boat travels 50 metres from D to E.

**How far away from F is the boat?**

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Length EF = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Robyn wants to know how wide the river is.

Standing at S, she notes a rock (R) on the far bank opposite.

She then turns 90◦ and walks 50 metres along the bank to point T.

From here she measures angle RTS as being 63◦.

T

S

R

Diagram is NOT drawn to scale.

F

(d) **Calculate the width of the river RS.**

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Distance RS = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Further down the river, 75 metres from S, at point F, is a fisherman. It so happens that the rock is 123 metres away from the fisherman (FR = 123 metres).

(e) **Calculate angle SFR.**

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Angle SFR = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(f) A flag pole is supported by 2 wires. The wires are connected to the same point on the pole.

One wire, 7.2 metres long, is bolted into concrete 5.1 metres from the pole.

The second wire forms an angle of 58◦ with the ground and is also bolted into some concrete.

**How long is the second wire? You are expected to show clear working to justify your final answer. Give your answer to 2 d.p.**

Diagram is NOT drawn to scale.

Wire 2

Wire 1

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**MATHEMATICS, 2010**

# Level 1

## 90153 Use geometric reasoning to solve problems.

# Credits: Two

### QUESTION AND ANSWER BOOKLET

**Answer ALL questions in the spaces provided in this booklet.**

**Show ALL working.**

|  |  |  |
| --- | --- | --- |
| **Achievement Criteria For Assessor’s use only** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Use geometric reasoning to solve problems. | Use, and state, geometric reasons in solving problems. | Solve an extended geometrical problem. |
| Overall Level of Performance | | |

**You must hand this booklet to the supervisor at the end of the examination.**

You are advised to spend 25 minutes on this paper.

You should attempt to answer all parts of all questions.

**Give geometric reasons for all answers. They are required for some grades.**

QUESTION ONE

1. Theo is interested in flag design and is experimenting with an idea to use geometric shapes to suggest a mountain and river.

G

E

54◦

F

H

Diagram is NOT drawn to scale.

GEF is an isosceles triangle (EG = GF) ∠ EGF = 54◦.

**Calculate ∠ GFH**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(b) Here is a diagram of the **rectangular** flag of The Bahamas.

A

B

C

E

D

F

Diagram is NOT drawn to scale.

Triangle ABC is equilateral. Line DE is parallel to AF.

**Calculate ∠ ADE.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(c) A common feature on flags is a 5-pointed star – a pentagram. This pentagram comprises a regular pentagon ABCDE (in the centre) and 5 isosceles triangles, one on each side of the pentagon.

A

B

C

Diagram is NOT drawn to scale.

E

D

F

Triangle ABF is one of the isosceles triangles with AF = BF.

**Calculate ∠ AFB.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(d) Another common shape appearing on flags is the triangle (in various forms). Here is a triangle with its exterior angles labeled a, b and c.

The interior angles of the triangle are labeled x, y and z.

b

a

c

x

y

z

Many people are aware that the interior angles of any triangle always add to the same total.

Prove, with geometric reasoning that this is true.

Hint: you might use standard rules about the sum of each pair of interior and exterior angles and also exterior angles of polygons.

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QUESTION TWO

1. Our moon looks like a circle in the sky.

The sun also looks circular – a circle that is 1,400,000 km in diameter. This is much bigger than the moon, but because the sun is further away, it actually seems to be about the same size.

This can be modeled with the following diagram where triangles abc and pqr are similar.

If the moon is 385,000 km away from us, i.e. ps = 385,000 km, and the sun is 150,000,000 km away, i.e. ad = 150,000,000 km, **what is the diameter of the moon, i.e. length qr?**

b

Diagram is NOT drawn to scale.

a

c

d

p

q

r

s

1,400,000 km

385,000 km

150,000,000 km

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(b) James Garfield was a President of the United States. He achieved hardly anything, mainly because he was killed by an assassin after just 4 months in office.

However he is remembered for one non-political thing he managed during those 4 months. He developed a proof for Pythagoras theorem.

Part of his proof used this diagram made by 3 triangles:

a

b

d

x

y

z

e

x

c

y

The triangles abc and cde are identical to each other and are arranged so that the line bd through c is one straight line.

**Calculate, showing geometric reasons, the size of angle z**

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Angle z = **\_\_\_\_\_\_\_\_\_\_\_\_\_**

(c) Circle ABC has its centre at O.

AO is parallel to BC. ∠ OAC = 22o

A

B

C

D

O

22o

Diagram is NOT drawn to scale.

**Calculate ∠ BDC**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Angle BDC = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(d) You are given a **rough, not-to-scale** sketch of a drainage plan.

E

B

95o

C

A

38o

Diagram is NOT drawn to scale.

D

F

90o

You are also given the following information about how the plan **should** be drawn.

∠ CAB = 38o. ∠ DEF = 90o BD = BF

AC is a tangent to the circle CDEF, touching the circle at C.

**Calculate ∠ CBF.**

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Angle CBF = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_